ANNUAL RESEARCH REPORT
FY 2009
25 November 2009

1) Title:

The Demography of Northern Spotted Owls (*Strix occidentalis caurina*) on the Willamette National Forest, Oregon.

2) Principal Investigator and Organizations:

Principal Investigator: Dr. Robert Anthony (Demography-RWU 4203); Biologists: Dr. Steven Ackers (Project Leader), Rita Claremont, Nicole Crull, Chris McCafferty, Alexis Smoluk, and Shona Wilson. Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU), Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

3) Study Objectives:

a. Estimate site occupancy rates, sex and age composition, nesting success, reproductive success and fecundity of the population of northern spotted owls on the Willamette National Forest.

b. Develop and maintain a capture history matrix of marked spotted owls to estimate survivorship and recruitment from mark-recapture models.

c. Obtain the data and parameter estimates required for periodic meta-analyses of fecundity, survivorship and annual rate of population change across the range of the northern spotted owl.

d. Examine the relationships between the above demographic parameters and land use allocations designated under the Northwest Forest Plan (NWFP)(USDA and USDI 1994).

e. Collaborate with other researchers examining northern spotted owl ecology throughout the Pacific Northwest.

4) Potential Benefit or Utility of the Study:

Studying the population demography, habitat selection, foraging ecology, and diets of northern spotted owls will continue to increase our understanding of the factors affecting spotted owl populations. The demographic parameters estimated by this study will continue to be an important part of the meta-analyses of northern spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999, Anthony et al. 2006). Our results supported the validation and monitoring requirements of the NWFP (USDA and USDI 1994) and were an important part of the 2004 status review. Data from this study also have been used in analyses of occupancy rates (Olson et al. 2005) and models to predict demographic rates from vegetative characteristics around nest sites (Olson et al. 2004). Our data continue to be used in new approaches to analyzing the effects of habitat, climate (Glenn 2009), and barred owl (*Strix varia*) presence on spotted owl demography.

5) <u>Study Description and Survey Design</u>:

Site occupancy, nesting and reproductive success, and fecundity were calculated through annual monitoring of a sample of northern spotted owl sites in the central Oregon Cascades. Color-banded spotted owls were identified at each site and their nesting and reproductive status were determined according to established protocols (Forsman 1995). Results were tabulated for the entire study area as well as for three land use allocations of late-successional reserves (LSR), adaptive management areas (AMA), and matrix. We were particularly interested in the productivity and survivorship of the northern spotted owls in the four LSRs on the study area as this land use allocation is intended to provide the habitat base for the recovery of the species.

Survivorship and annual rate of population change were calculated at five-year intervals within a mark-recapture framework. These results were used in the meta-analyses of the spotted owl populations throughout their range (Burnham et al. 1996, Franklin et al. 1999, Anthony et al. 2006, Forsman et al. 2009).

In February 2009, the master site numbering system (MSNO) and the associated locations for the site centers maintained by the Oregon Department of Fish and Wildlife (ODFW) were reviewed and compared to the site center database maintained by the Willamette National Forest (WNF). The name and master site number of 44 sites in the database were revised to match the earliest site centers in the ODFW database (Appendix 1). In most cases, this required only a change in the name or MSNO of the sites that we monitored. In five instances, this required re-assignment of survey results to better reflect the survey effort at particular ODFW site centers. The figures and summary tables in this report have been revised to reflect these changes.

We continued to monitor sites where spotted x barred owl hybrids have been located. These results were presented separately. Unless otherwise indicated, the following discussion was pertinent only to our analyses of spotted owl demography.

6) <u>Research Accomplishments (Demography) for FY 2009</u>:

Site occupancy

Survey effort in 2009 was greater than reported for 2008 (168 versus 155 sites surveyed) and was similar to the level reported in 2006. Two sites were surveyed less than twice at night after resident owls from nearby sites were detected.

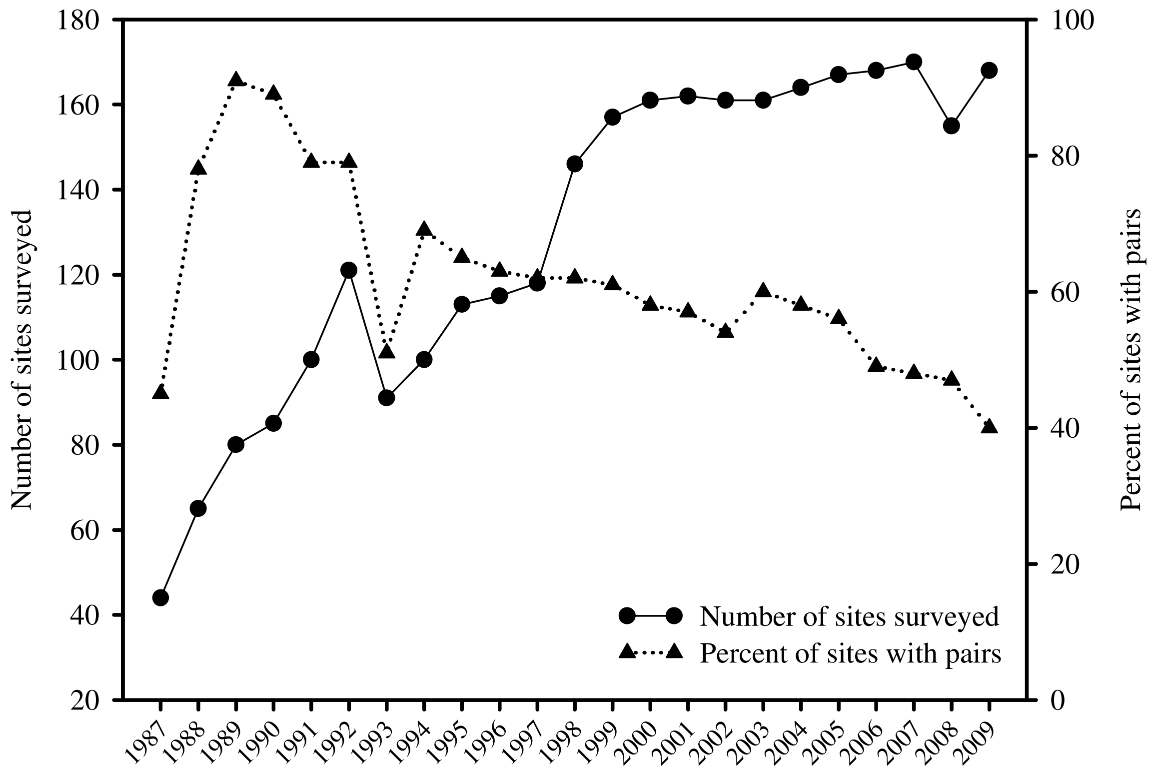

Figure 1. Number of sites surveyed for northern spotted owls and the percentage of those sites occupied by pairs in the central Cascades study area, Willamette National Forest, Oregon from 1987 – 2009.

Most of the occupied sites surveyed in 2009 were occupied by pairs (66%) and substantially fewer were occupied by resident single owls (19%) or single owls with unknown residency status (15%, Table 1). Simple occupancy (*i.e.*, sites with either a pair or a single owl) decreased by 1% while pair occupancy decreased by 7% between 2008 and 2009. These are the lowest occupancy levels recorded to date (Figure 1, Table 1). The residency status of either the male and/or the female was unknown for 4 (6%) of the pairs. The percentage of sites occupied by territorial single owls decreased by 3% (Table 1). The percentage of unoccupied sites was the highest since the initiation of the study (39%, Table 1).

The highest estimates of simple occupancy in 2009 were in the AMA land allocation (66%), which increased 7% over the 2008 estimate. The current estimate still represents a decrease from pre-2008 estimates, however. Simple occupancy in the LSR allocation was less than the other two primary land use allocations (57%) and has continued to decrease since 2000 when we began monitoring all of the sites in the LSRs. The matrix allocation also decreased in simple occupancy by 4% (Table 2).

Table 1. Occupancy and residency status of northern spotted owl sites (territories) surveyed on the central Cascades study area, Willamette National Forest, Oregon, 1987 – 2009.

Year	Sites surveyed [a]	Sites with pairs	Sites with single owls	Sites with residency unknown [b]	Occupied sites (%)	Unoccupied sites [c]	Sites with unknown occupancy [d]
1987	44	20	2	4	26 (59)	-	18
1988	65	51	2	1	54 (83)	-	11
1989	80	73	4	3	80 (100)	-	27
1990	85	76	0	3	79 (93)	6	27
1991	100	79	5	8	92 (92)	8	3
1992	121	96	4	14	114 (94)	7	28
1993	91	46	13	15	81 (89)	10	19
1994	100	69	7	22	98 (98)	2	19
1995	113	73	10	8	91 (80)	22	12
1996	115	73	11	6	90 (78)	25	5
1997	118	73	8	10	91 (77)	27	12
1998	146	90	8	14	112 (77)	34	17
1999	157	95	13	15	123 (78)	34	11
2000	161	93	8	25	126 (78)	36	0
2001	162	93	11	29	133 (82)	29	2
2002	161	87	12	28	127 (79)	34	3
2003	161	96	11	18	125 (78)	36	1
2004	164	95	6	23	124 (76)	40	3
2005	167	93	19	19	131 (78)	36	2
2006	168	83	12	23	118 (70)	50	0
2007	170	82	9	26	117 (69)	53	0
2008	155	73	5	18	96 (62)	59	15
2009	168	68	20	15	103 (61)	65	2

[a] Occupancy and residency were determined by 1995 protocols (Forsman 1995).
[b] Residency status was undetermined at sites where responses were obtained from male and/or female owls but criteria for pair or resident single occupancy status were not met.
[c] Unoccupied sites were surveyed at least three times at night with no responses or where owls from a neighboring site were detected.
[d] Sites with fewer than 3 night visits.

Table 2. Occupancy and residency status of northern spotted owl sites by land-use allocation[a] on the central Cascades study area, Willamette National Forest, Oregon, 1997 – 2009.

Land use allocation [b]	Year	Sites surveyed	Sites with pairs	Sites with single owls	Sites with unknown social status	Occupied sites (%)	Unoccupied sites	Sites with unknown occupancy
Matrix	1997	40	29	2	0	31 (78)	9	2
	1998	41	26	3	2	31 (76)	10	3
	1999	42	26	3	1	30 (71)	12	2
	2000	39	24	2	5	31 (79)	8	0
	2001	38	26	3	6	35 (92)	3	1
	2002	38	22	2	7	31 (82)	7	0
	2003	37	26	1	3	30 (81)	7	1
	2004	38	25	1	5	31 (82)	7	0
	2005	39	25	2	4	31 (79)	8	0
	2006	39	22	1	4	27 (69)	12	0
	2007	39	23	1	1	25 (64)	14	0
	2008	37	23	0	2	25 (68)	12	2
	2009	39	20	4	1	25 (64)	14	0
AMA	1997	45	31	4	1	36 (80)	9	3
	1998	44	33	1	4	38 (86)	6	1
	1999	43	30	2	4	36 (84)	7	1
	2000	43	30	2	1	33 (77)	10	0
	2001	44	27	4	5	36 (82)	8	0
	2002	42	27	4	5	36 (86)	6	2
	2003	43	30	2	4	36 (84)	7	0

Land use allocation [b]	Year	Sites surveyed	Sites with pairs	Sites with single owls	Sites with unknown social status	Occupied sites (%)	Unoccupied sites	Sites with unknown occupancy
AMA (*cont.*)	2004	45	26	2	4	32 (71)	13	0
	2005	45	26	9	5	40 (89)	5	0
	2006	45	24	4	7	35 (78)	10	0
	2007	47	22	4	11	37 (79)	10	0
	2008	44	21	1	4	26 (59)	18	3
	2009	44	19	5	5	29 (66)	15	1
LSR	1997	27	8	2	9	19 (70)	8	7
	1998	55	27	3	8	38 (69)	17	13
	1999	66	35	7	10	52 (79)	14	8
	2000	73	35	2	18	55 (75)	18	0
	2001	74	35	4	18	57 (77)	17	1
	2002	75	34	6	14	54 (72)	21	0
	2003	75	36	8	11	55 (73)	20	0
	2004	75	41	2	13	56 (75)	19	2
	2005	77	40	8	7	55 (71)	22	0
	2006	78	34	7	10	51 (65)	27	0
	2007	77	35	4	12	51 (66)	26	0
	2008	68	27	4	11	42 (62)	26	9
	2009	77	27	9	8	44 (57)	33	1

[a] See the Northwest Forest Plan (USDA and USDI 1994) for a description of land use allocation forest management strategies.
[b] Sites with LUA designation of ■Other•, ■Private•, and ■Wilderness• are not included here

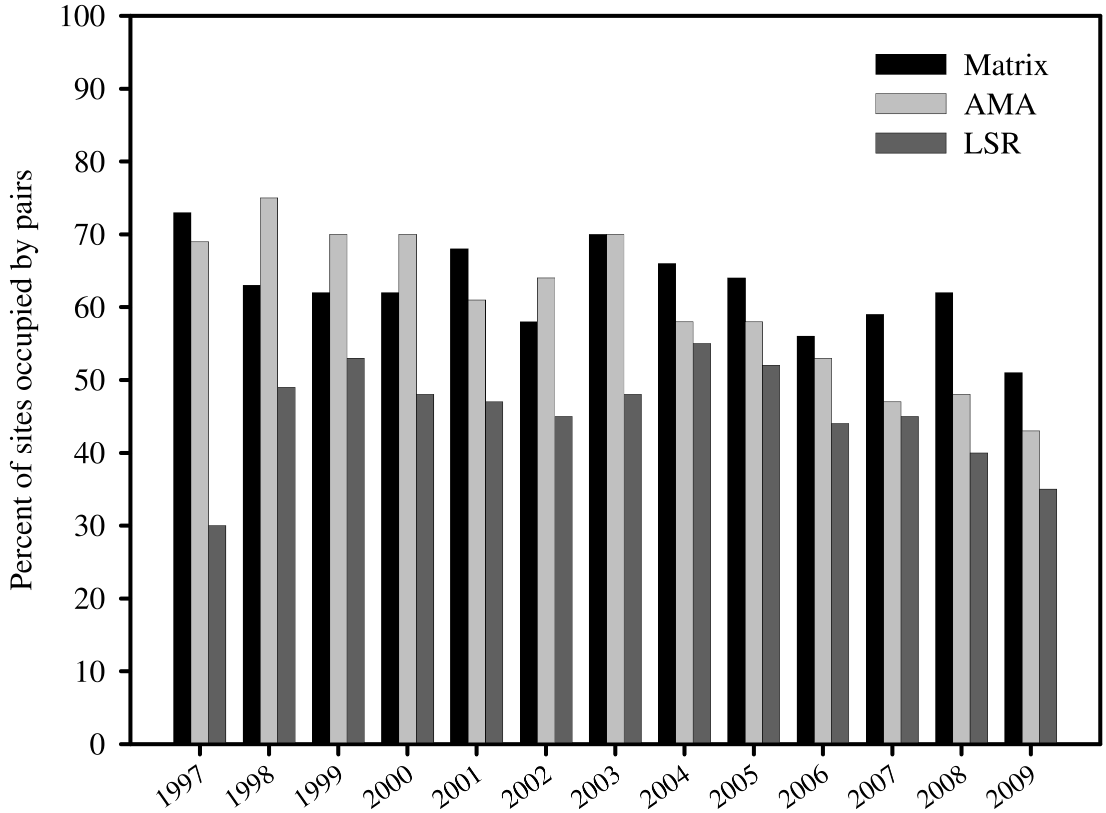

Figure 2. Percentage of sites occupied by pairs of northern spotted owls compared among land use allocations in the central Cascades study area, Willamette National Forest, Oregon from 1997 – 2009.

Pair occupancy in all three primary land use allocations decreased between 2008 and 2009 with the greatest decrease observed in the matrix allocation, which lost 3 pairs (11%, Figure 2). The AMA and LSR allocations both decreased by 5% pair occupancy. This reflected a loss of 2 pairs in the AMA allocation but there was no net gain or loss of pairs in the LSR allocation. Pair occupancy decreased by two sites in the Fall Creek LSR. One additional pair was located in each of the Hagan and South Santiam LSRs, and an equal number of pairs were located in the Horse Creek LSR (Appendix 3). Overall, LSR sites continued to have lower levels of pair occupancy (35%) relative to matrix (51%) and AMA sites (43%). Although pair occupancy in the land use allocations has varied over time, no difference in time trends were apparent. In some years, pair occupancy may have decreased in one allocation but increased in the others (e.g., 2003 – 2004), but the overall trend has been a decrease in all three allocations.

Seven additional sites were surveyed in other land use allocations such as research natural areas and wild and scenic river corridors. Two of these sites were occupied by pairs, one by a resident female, one by a single owl of unknown residency status, and three were unoccupied. An unbanded, unknown sex spotted owl also was located in an intervening area south of one of these sites.

Sex and age composition

At least 187 non-juvenile and 28 juvenile spotted owls were detected in 2009 (Table 3). The majority of the non-juvenile owls of known age were at least three years old (97%). Five spotted owls were identified as subadults: three two-year-old males, one two-year-old female, and one two-year-old spotted owl of undetermined sex. Of the owls that were not identified to age class (17%), most were detected as nocturnal auditory responses only and were not relocated on the daytime follow-ups. All of the owls that were identified by reading their color bands (155) were assigned to an age class. One adult male and one subadult male wearing fledgling bands were not captured for identification. One unbanded adult female also was located but not captured and a second adult female was located but the observer could not determine if she was banded. Finally, a subadult of undetermined sex was recaptured and its fledgling band replaced with a unique adult color band. This owl did not vocalize but we tentatively classified it as a female pending future resightings of this owl.

The sex ratio (males:females) among adults (three-year-olds and older) identified in 2009 was similar to past estimates (1.12:1 for 2009, 1.12:1 averaged over all previous years). Among subadults, the sex ratio was more skewed toward males in most years (1.47:1 averaged over all years). Small sample sizes in the subadult age class resulted in more annual variation in the sex ratios which ranged from 0:1 in 1994 to 2.25:1 in 1988. More subadult females than males were detected in only 5 of the past 23 years (e.g., 0.64:1 for 2003). The average sex ratio among unclassified non-juveniles was even more variable and heavily skewed toward males ($\bar{x}$ = 2.35:1, range: 0.75:1 - 14:1). Most of these unclassified owls were detected only once at night and were never relocated for identification, which suggested that many of them were transients that did not hold territories.

Among paired owls, only one (1.5%) of the females was a subadult in 2009. Subadults have been paired much less frequently than adults in every year of the study. The percentage of pairs with at least one subadult has varied widely from a high of 15.1% in 1988 to a low of 0.68% in 1995. A ■lag effect• of increased proportions of paired subadults 1 - 2 years following years of high productivity has been observed, although not consistently (Figure 3). There was no evidence of a trend toward an increasing proportion of subadults in the population of territorial pairs.

Nest success

We were able to survey 34 spotted owl pairs and one resident single female prior to 1 June 2009 to determine nesting status according to protocol (Forsman 1995, (Figure 4). The percentage of pairs that attempted to nest (32%) was less than the average over all previous years ($\bar{x}$ = 48%, SE = 5.3). The percentage of nesting pairs that fledged at least one young was exceptionally high (91% in 2009, $\bar{x}$ = 69%, SE = 4.5 over all previous years). One nesting pair was still delivering mice to a nest on 7 June but did not show any nesting behaviors on subsequent visits and did not fledge any young. All of the nesting spotted owls that were identified were adults. One nesting female was not identified and could not be assigned to an age class.

Table 3. Sex and age composition of northern spotted owls on the Central Cascades Study Area, Willamette National Forest, Oregon, 1987 – 2009.

Year	Adults (M, F)	Subadults [a] (M, F)	Age unknown (M, F)	Non-juveniles [b] (M, F)	Juveniles [c]
1987	53 (29, 24)	6 (3, 3)	15 (14, 1)	74 (46, 28)	12
1988	98 (49, 49)	13 (9, 4)	9 (4, 5)	120 (62, 58)	40
1989	135 (72, 63)	13 (7, 6)	14 (8, 6)	162 (87, 75)	27
1990	134 (72, 62)	9 (2, 7)	28 (17, 11)	171 (91, 80)	37
1991	152 (82, 70)	12 (6, 6)	44 (25, 19)	208 (113, 95)	30
1992	170 (88, 82)	8 (3, 5)	30 (17, 13)	208 (108, 100)	116
1993	122 (72, 50)	6 (4, 2)	23 (16, 7)	151 (92, 59)	0
1994	144 (77, 67)	6 (0, 6)	14 (8, 6)	164 (84, 79)	28
1995	151 (76, 75)	2 (2, 0)	19 (13, 6)	172 (91, 81)	22
1996	140 (71, 69)	8 (4, 4)	17 (13, 4)	165 (88, 77)	68
1997	139 (71, 68)	9 (5, 4)	21 (9, 12)	169 (85, 84)	24
1998	172 (86, 86)	8 (6, 2)	40 (27, 13)	220 (119, 101)	42
1999	169 (89, 80)	2 (2, 0)	56 (36, 20)	227 (127, 100)	21
2000	169 (85, 84)	6 (5, 1)	53 (36, 17)	228 (126, 102)	60
2001	189 (98, 91)	7 (4, 3)	38 (25, 14)	234 (127, 107)	83
2002	168 (89, 79)	11 (4, 7)	46 (26, 20)	225 (119, 106)	67

Year	Adults (M, F)	Subadults [a] (M, F)	Age unknown (M, F)	Non-juveniles [b] (M, F)	Juveniles [c]
2003	172 (93, 79)	18 (7, 11)	40 (21, 19)	230 (121, 109)	25
2004	187 (99, 88)	13 (7, 6)	29 (19, 10)	229 (125, 104)	105
2005	171 (92, 79)	11 (5, 6)	54 (33, 21)	236 (130, 106)	13
2006	149 (82, 67)	11 (6, 5)	37 (23, 14)	197 (111, 86)	20
2007	178 (90, 88)	2 (1, 1)	30 (24, 6)	210 (115, 95)	48
2008	154 (82, 72)	4 (2, 1, 1 Unk.)	18 (10, 8)	176 (93, 81, 1 Unk.)	31
2009	155 (82, 73)	5 (3, 1, 1 Unk.)	27 (19, 8)	187 (104, 82, 1 Unk.)	28

[a] One- and two-year-old age classes combined.
[b] Adults and subadults combined.
[c] Includes the total number of young located from 1 April to 31 August, including pre- and post-fledging mortalities.

Reproductive success

Sixty-three spotted owl pairs and two resident single females were checked for reproductive status prior to 31 August 2009 (Table 4, Figure 5). This included the 34 pairs that were surveyed for nesting status as well as 29 additional pairs that were not located prior to 1 June or were located at high elevation sites that were not accessible before that date.

The average number of young produced per successful pair ($\bar{x}$ = 1.75 young/successful pair) was higher than the average over all previous years of the study ($\bar{x}$ = 1.59, SE = 0.05; Table 4). With the exception of 1993 when no young were fledged, there was little variation in the number of young produced by pairs that successfully nested. For all pairs surveyed for reproductive status, the average number of young produced per pair in 2009 (0.44 young/pair) was less than the combined average for previous years ($\bar{x}$ = 0.59, SE = 0.08; Table 4).

Fecundity was calculated as the average number of female offspring per female checked for reproductive status twice before 31 August (Forsman 1995). The fecundity estimate for 2009 was 0.22 female young/adult female (SE = 0.05, Figure 5), which was less than the average over previous years ($\bar{x}$ = 0.29, SE = 0.06).

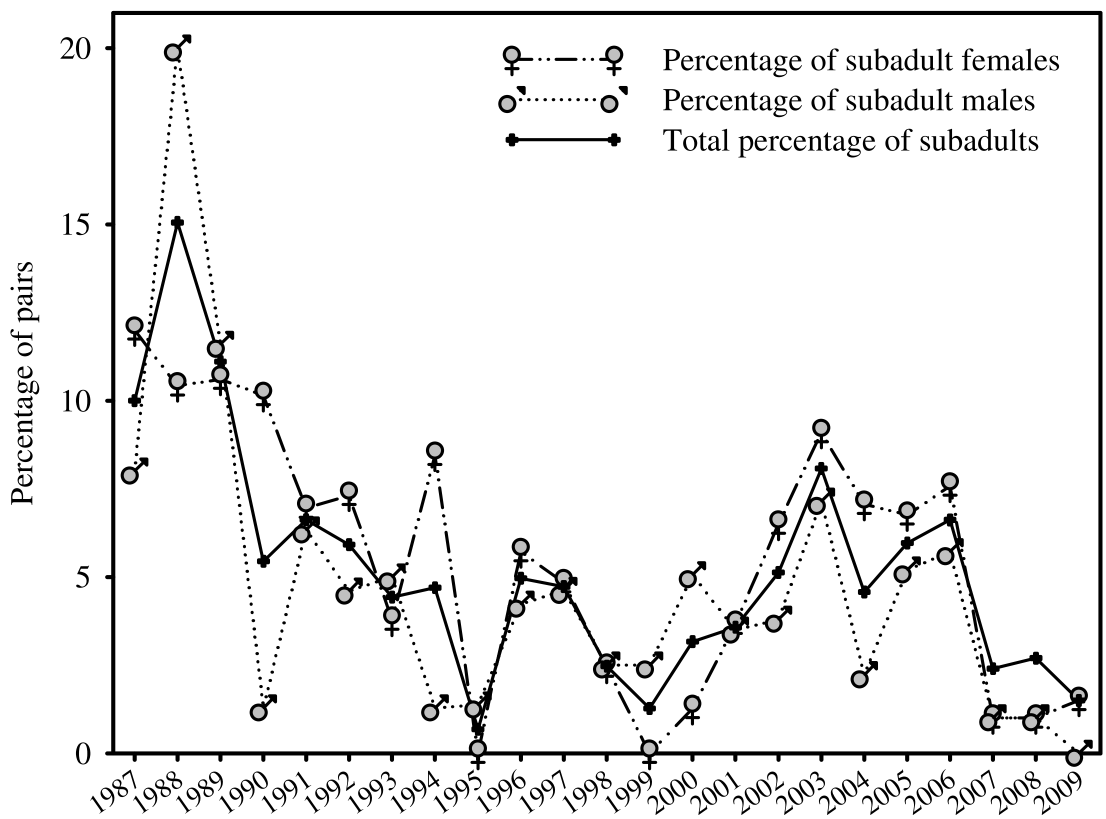

Figure 3. Percentage of pairs that included at least one subadult in the central Cascades study area, Willamette National Forest, Oregon from 1987 – 2009.

Spotted owl productivity increased in the matrix land use allocation but decreased in the AMA and LSR lands in 2009 (Table 5). Productivity in the Fall Creek LSR (0.31 young fledged/pair) dropped sharply to less than half of the average number of young produced per pair for that reserve ($\bar{x}$ = 0.65, SE = 0.13). Productivity in the other three LSRs remained negligible (Appendix 4).

Banding/re-observation

Thirty-eight spotted owls were banded in the study area and at four nearby wilderness sites in 2009 including 27 fledglings, 2 subadults and 9 adults (Table 6). From 1987 - 2009, 647 non-juveniles and 889 fledglings have been banded for a grand total of 1,521 banded spotted owls. Based on re-observations of banded non-juvenile owls in 2009, the minimum average age for males on the study area was 9.6 years (SE = 0.53) and 8.0 years (SE = 0.52) for females. The oldest owl located in 2009 was a 23-year-old male banded as an adult in 1989. The oldest female was 19 years old; she was banded in 1990 as a fledgling.

There were 17 movements of spotted owls between site centers within the study area in 2009. Fifteen adult owls and two subadult owls were recaptured or re-sighted at new locations within our study area. No movements from outside the study area were documented. Five owls originally banded as fledglings were recaptured and fitted with adult bands; two were originally banded in 2007 and one each was banded in 2006, 2001 and 2000. Since the initiation of the study in 1987, 113 (13%) of the fledglings banded in our study area have been recaptured and marked with adult bands. Fourteen (12%) of the banded fledglings were recaptured as one-year-olds, 32 (28%) as two-year-olds, and 67 (59%) as adults. Most (65%) marked fledglings were recaptured within three years after banding. Among those recaptured as adults, most were recaptured after 3 or 4 years. The longest period of time between initial banding and recapture was 12 years (Figure 6). Individuals not recaptured after 5 or more years may have been territorial breeders outside of the study area previously.

Meta-analysis of spotted owl demography

A subset of the productivity and mark-recapture data summarized in this report were combined with data from 10 other studies in a meta-analysis of the range-wide trends in spotted owl populations (Forsman et al. 2009). Fecundity, apparent survival, and annual rates of change were estimated and several *a priori* models were evaluated using techniques employed in previous meta-analyses (Franklin et al. 1999, Anthony et al. 2006). Covariates that quantified variation in barred owl occupancy, habitat change and climate also were included in the models to evaluate the potential causes for any observed trends in fecundity, apparent survival, and the annual rate of population change (λ). The data were analyzed for each study area individually and in meta-analyses, which pooled the data from all of the studies. Here, we focus on the results for this study area.

The best fecundity models from the analyses of individual study areas included effects of age, even/odd year variation, habitat, barred owls, late nesting season precipitation, and a linear time trend (Table 7). Age-specific fecundity estimates were lower for subadults compared to adult owls (1-year-olds: $\bar{x}$ = 0.083, SE = 0.083; 2-year-olds: $\bar{x}$ = 0.110, SE = 0.043; adults: $\bar{x}$ = 0.323, SE = 0.041). The even/odd year variation in fecundity continued to be an important effect despite the break in this pattern that occurred between 2000 – 2002 and 2007 – 2008 (Figure 5). A positive effect of the amount of suitable habitat within 2.4 km of site centers was evident in all of the top models (β = 11.313, 95% CI: 5.787 – 16.475). Other models also provided weak evidence of a positive barred owl effect (ΔAIC_c = 0.10, β = 0.551, 95% CI: -0.059 – 1.160), a positive linear time trend (ΔAIC_c = 1.20, β = 0.010, 95% CI: -0.006 – 0.027), and a negative effect of precipitation during the late nesting season (ΔAIC_c = 1.40, β = 0.004, 95% CI: -0.011 – 0.003) on fecundity (Forsman et al. 2009).

Several models for apparent survival were competitive with the best model, and all included effects of sex and annual variation on re-sighting probabilities and age and variable time (t) effects on apparent survival (Table 8). The age effect on survival indicated lower survival in the subadult age classes compared to adults (1-year-olds: φ = 0.717, SE = 0.084; 2-year-olds: φ = 0.830, SE = 0.042; adults: φ = 0.864, SE = 0.010). A competitive model included a cut-point effect on survival suggesting that apparent survival before 2004 differed from that after 2004 ($\Delta QAIC_c$ = 0.679). The coefficient suggested that apparent survival had increased after 2004,

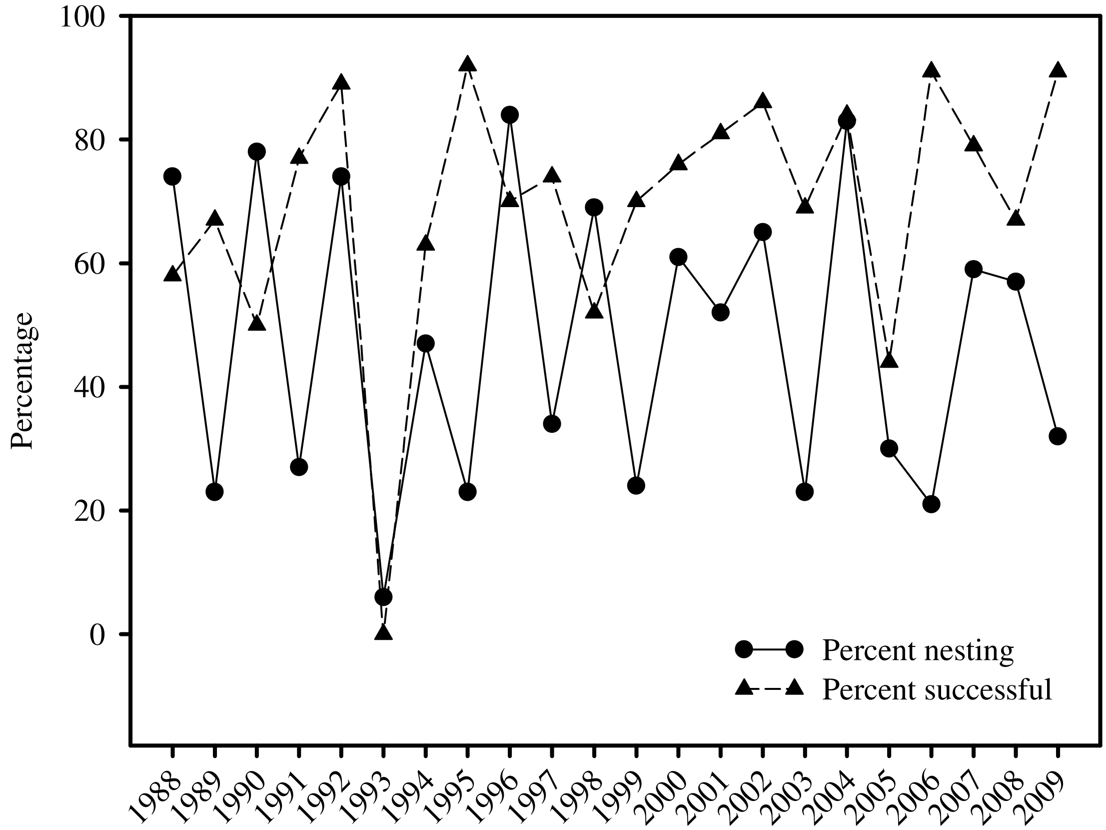

Figure 4. Percentage of pairs confirmed nesting prior to 1 June 2009 and the percentage of nesting pairs that fledged at least one young in the central Cascades study area, Willamette National Forest, Oregon from 1988 – 2009.

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although the confidence interval included 0 (β = 0.021, 95% CI: -0.009 – 0.015). The model that included a barred owl effect on survival was marginally competitive ($\Delta QAIC_c$ = 2.238), and a negative effect was indicated by the regression coefficient and 95% confidence interval (β = -0.753, 95% CI: -1.352 – -0.153). There was little evidence of an effect of reproduction, habitat change or climate on apparent survival in our study area.

The annual rate of population change (λ_{RJS}) indicated an average annual population decline of 2.2% per year (λ_{RJS} = 0.978, 95% CI: 0.957 – 0.996). This is nearly the same estimate as calculated in 2004 (Anthony et al. 2006) but with greater precision due to an increased sample size. This provides stronger evidence that the population declined over the course of the study than the previous estimate. The best model included a quadratic time trend on annual estimates of λ in which most of the decline occurred from 1992 – 93 and 2004 – 06 (Figure 7). The estimates for the realized population change indicated that the population had declined between 20% – 30% since 1991 (Forsman et al. 2009).

Table 4. Summary of reproductive surveys for northern spotted owls in the Central Cascades Study Area, Willamette National Forest, Oregon from 1988 – 2009.

Year	Number of pairs checked [a]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)
1988	39	20 (51)	35	1.75	0.90
1989	49	10 (20)	17	1.70	0.35
1990	63	29 (46)	36	1.24	0.57
1991	58	16 (28)	30	1.88	0.52
1992	61	47 (77)	86	1.83	1.41
1993	50	0 (0)	0	N/A[b]	0.0
1994	63	21 (33)	28	1.33	0.44
1995	73	13 (18)	22	1.69	0.30
1996	66	42 (64)	68	1.62	1.03
1997	63	15 (24)	24	1.60	0.38
1998	81	28 (35)	41	1.46	0.51
1999	76	11 (14)	21	1.91	0.28
2000	76	37 (49)	60	1.62	0.79
2001	86	48 (56)	81	1.69	0.94
2002	76	42 (55)	62	1.48	0.82
2003	76	14 (18)	25	1.79	0.33
2004	92	62 (67)	100	1.61	1.09
2005	67	12 (18)	13	1.08	0.19
2006	66	13 (20)	20	1.54	0.30
2007	70	31 (44)	48	1.55	0.69
2008	62	22 (35)	31	1.41	0.50
2009	63	16 (25)	28	1.75	0.44

[a] Includes pairs that were given at least four mice on two or more occasions prior to 31 August.
[b] Not applicable because no pairs were successful in producing young in 1993.

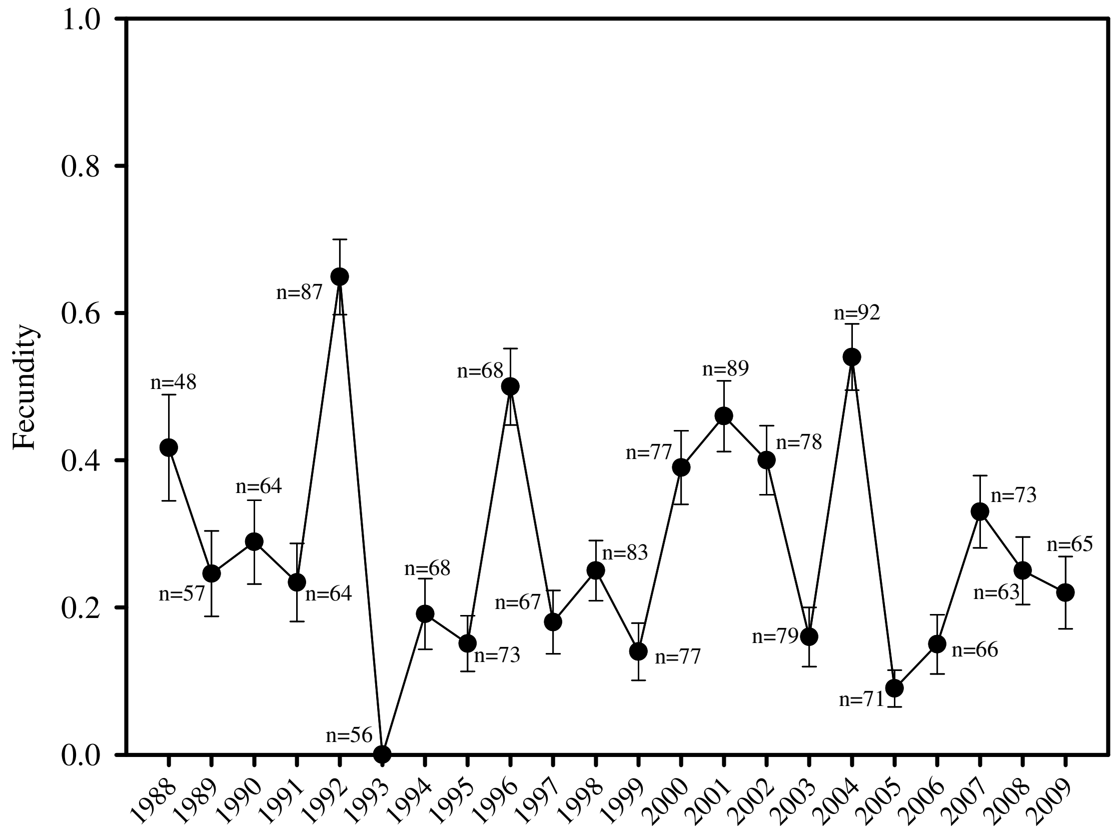

Figure 5. Annual fecundity estimates for the central Cascades study area, Willamette National Forest, Oregon from 1988 – 2009. Sample sizes indicate the numbers of paired and single female northern spotted owls checked for reproductive status before 31 August of each year.

Wilderness surveys

Six sites located in the Three Sisters and Mount Washington Wilderness Areas near the study area boundary have been surveyed on an irregular basis from 1989 through 1996. Since 1997, these sites have been surveyed annually. Pair occupancy was initially high in the wilderness sites but has declined between 2000 and 2004. In 2005, pair occupancy increased to 5 of the 6 sites but no young were produced. Pair occupancy returned to the previous level in 2006 but only one pair produced young. In 2007, pairs were located at three sites, and all three pairs successfully fledged at least one offspring. Only two pairs were located in 2008, and three were located in 2009. No young have been produced in these sites for the past two years (Table 7).

Thirty-five sites located in the Three Sisters and Mount Washington Wilderness Areas were surveyed irregularly from 1987 through 1999. Twenty-eight owls have been banded at these sites, although only one male owl was later relocated on the study area. One male and one female owl banded on the study area were re-sighted in the wilderness, but survey effort at these

Table 5. Summary of reproductive success of northern spotted owls stratified by land use allocation on the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 – 2009.

Land use allocation [a]	Year	Number of pairs [b]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)	Mean fecundity (number of females)
Matrix	1997	25	6 (24)	10	1.67	0.40	0.19 (26)
	1998	24	12 (50)	17	1.42	0.71	0.34 (25)
	1999	23	1 (4)	2	2.00	0.09	0.04 (23)
	2000	23	10 (43)	17	1.70	0.74	0.35 (24)
	2001	26	10 (38)	17	1.70	0.65	0.31 (27)
	2002	19	11 (58)	16	1.45	0.84	0.42 (19)
	2003	22	2 (9)	3	1.50	0.14	0.07 (22)
	2004	25	19 (76)	30	1.58	1.20	0.60 (25)
	2005	21	3 (14)	3	1.00	0.14	0.07 (21)
	2006	20	6 (30)	10	1.67	0.50	0.25 (20)
	2007	20	10 (48)	15	1.50	0.75	0.36 (21)
	2008	20	6 (30)	9	1.50	0.45	0.23 (20)
	2009	20	9 (43)	17	1.89	0.85	0.40 (21)
AMA	1997	28	8 (29)	13	1.63	0.46	0.23 (28)
	1998	32	7 (22)	9	1.29	0.28	0.14 (32)
	1999	29	5 (17)	9	1.80	0.31	0.15 (30)
	2000	25	12 (48)	20	1.67	0.80	0.40 (25)
	2001	24	14 (54)	24	1.71	1.00	0.46 (26)
	2002	25	10 (40)	13	1.30	0.52	0.25 (26)
	2003	23	4 (17)	8	2.00	0.35	0.17 (23)
	2004	26	19 (73)	32	1.68	1.23	0.62 (26)

Land use allocation [a]	Year	Number of pairs [b]	Number (%) of pairs fledging young	Number of young fledged	Average number of young per successful pair	Average number of young per pair (all pairs)	Mean fecundity (number of females)
AMA	2005	19	7 (33)	8	1.14	0.42	0.19 (21)
	2006	20	5 (25)	8	1.60	0.40	0.20 (20)
	2007	16	4 (25)	6	1.50	0.38	0.19 (16)
	2008	17	10 (59)	15	1.50	0.88	0.44 (17)
	2009	17	3 (18)	5	1.67	0.29	0.15 (17)
LSR [c]	1997	5	0 (0)	0	0.00	0.00	0.00 (8)
	1998	21	7 (32)	12	1.71	0.57	0.27 (22)
	1999	20	5 (25)	10	2.00	0.50	0.25 (20)
	2000	24	14 (68)	22	1.57	0.92	0.46 (24)
	2001	32	22 (69)	37	1.68	1.16	0.58 (32)
	2002	28	19 (66)	31	1.63	1.11	0.53 (29)
	2003	27	5 (17)	9	1.80	0.33	0.15 (30)
	2004	38	22 (56)	34	1.55	0.89	0.45 (38)
	2005	26	2 (7)	2	1.00	0.08	0.04 (28)
	2006	24	2 (8)	2	1.00	0.08	0.04 (24)
	2007	32	15 (47)	23	1.53	0.72	0.35 (33)
	2008	23	6 (25)	7	1.17	0.30	0.15 (24)
	2009	24	4 (17)	6	1.50	0.25	0.13 (24)

[a] Sites with LUA designation “Other” not reported.
[b] Includes only pairs that were given at least 4 mice on two or more occasions prior to 31 August.
[c] The LSR estimates computed for 1998 - 2004 include the Fall Creek LSR which was not surveyed in 1997.

Table 6. Numbers of new spotted owls banded, re-sighted, and recaptured in the central Cascades study area and in nearby wilderness sites in the Willamette National Forest, Oregon during 2009.

	New owls banded			Owls re-sighted			Owls recaptured		
Age Class	Males	Females	Unk.	Males	Females	Unk.	Males	Females	Unk.
Adult	1	7	1	77	58	0	3	6	0
Subadult	0	1	1	1	0	0	1	0	1
Juvenile	-	-	27	-	-	-	-	-	-

sites was inadequate to estimate dispersal across the wilderness boundary.

Barred owl occupancy

The percentage of sites where at least one response from a barred owl was recorded was highest since the initiation of the study (38%). Although barred owl pair occupancy decreased slightly from the high of 14% in 2008 to 12% in 2009, detections of single barred owls increased to 26% in 2009 (Figure 8). Barred owls were detected at two sites with no previous history of barred owl detections.

Hybridization with barred owls

Since 1999, we have located as many as 14 non-juvenile spotted-barred owl hybrids at 17 different sites (Appendix 5). In addition, we have documented one instance of a spotted-barred pair producing 2 hybrid young and five instances of hybrid-barred pairs producing one or two backcross young (a total of 8 backcross young). We banded five of the hybrids and 3 of the backcross young. Only one of the banded hybrids was relocated in 2009: a hybrid female that has remained paired with a spotted owl male for 3 years. A single male hybrid also was detected at night in a site with no previous history of hybrid detections.

Only three of the hybrids located since 1999 were found outside of an LSR: the first hybrid-barred owl pair was located west of the Fall Creek LSR in 1999, a hybrid female was found near a historic spotted owl nest site within a Wild and Scenic River corridor along the McKenzie River in 2004, and a hybrid was detected in two neighboring matrix sites in 2006 and 2007. Eleven of the other 13 hybrid detections were in the Fall Creek LSR; another hybrid was located in the Horse Creek LSR in 2002, and the most recent hybrid detection occurred in the South Santiam LSR. Two of the hybrids immigrated over 100 km from their initial banding locations in the Klamath and Roseburg study areas to the Fall Creek LSR.

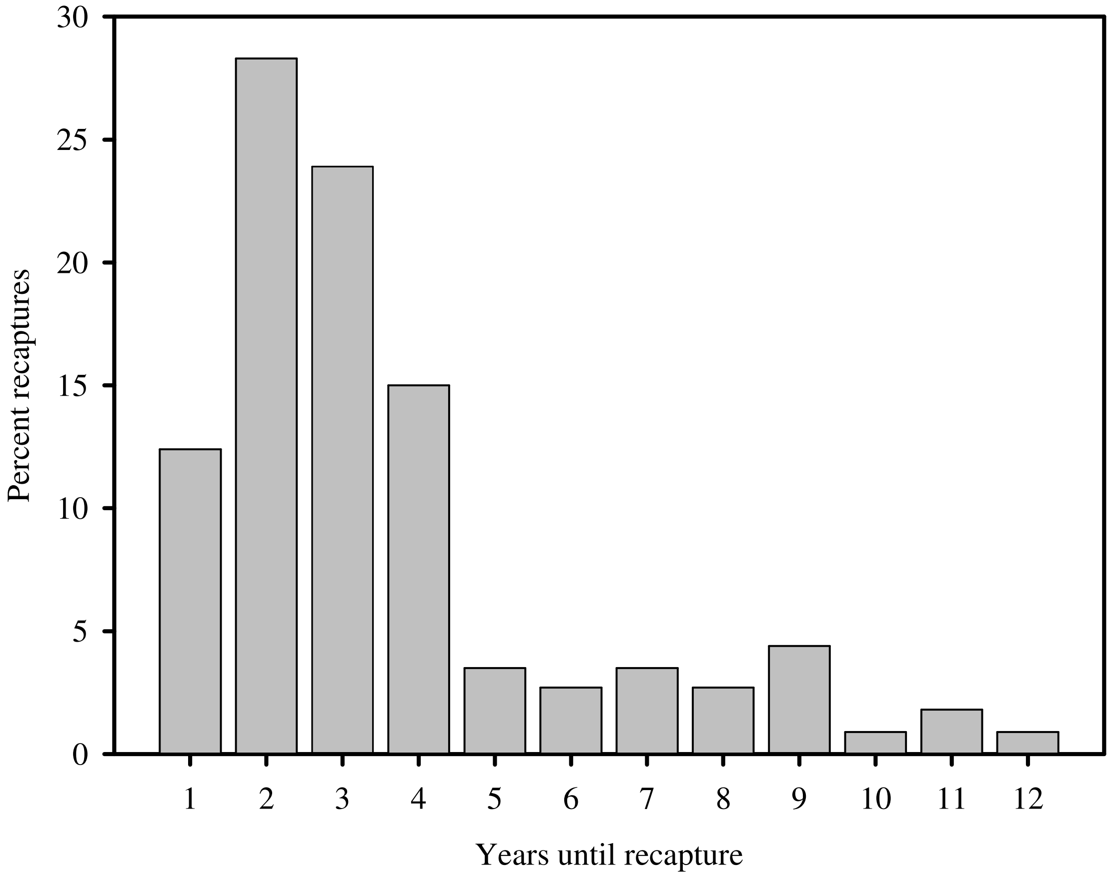

Figure 6. Years until the first recapture of northern spotted owls banded as fledglings in the central Cascades study area, Willamette National Forest, Oregon from 1987 – 2009.

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7. <u>Discussion</u>

Occupancy

Simple occupancy estimates included any spotted owl response at a site including auditory detections from unidentified individuals. These detections may have been from territorial or non-territorial owls. The average decline in simple occupancy was a conservative index of population decline for two reasons. First, sites occupied by pairs that lose one individual were still considered occupied and secondly, an unknown number of owls may have been counted at more than one site which inflated the number of sites considered occupied. In spite of these sources of positive bias, simple occupancy decreased an average of 1.9% per year. This may be an indication that both the territorial and non-territorial segments of the spotted owl population were declining.

Pair occupancy was a more reliable index of the breeding population than simple occupancy because each pair was confirmed at only one site, and it was rare that a pair remained

Table 7. Model selection results from the analysis of fecundity in the central Cascades study area, Willamette National Forest, Oregon conducted during the 2009 meta-analysis (from Forsman et al. 2009). Only competing models with $\Delta AIC_c < 2.00$ are listed.

Model [a]	ΔAIC_c	AIC_c weights	Number of parameters
A + EO + HAB1	0.00	0.17	6
A + EO + BO + HAB1	0.10	0.16	7
A + EO + T + HAB1	1.20	0.09	7
A + EO + LNP + HAB1	1.40	0.08	7

[a] Covariates used in the models: A = age class, EO = even/odd year effect, HAB1 = change in the percent suitable owl habitat within 2.4 km of site centers, BO = barred owl effect, T = linear time trend, LNP = precipitation during the late nesting season (1 May – 30 June).

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unidentified and inadvertently counted at two sites. The initial increase in pair occupancy from 1987 – 1989 is probably related to increased survey effectiveness as site centers were located.

The lowest occupancy estimates to date were observed in all three allocations in 2009 but occupancy has been lowest in the LSR allocation in most years. (Table 2, Figure 2). Changes in occupancy in the LSR allocation are particularly pertinent to the effectiveness of the Northwest Forest Plan, as these areas were closely linked to the reserve designs for the recovery of the northern spotted owl. Our results indicated that not all LSRs were equally capable of supporting breeding pairs of spotted owls. The Fall Creek LSR lost 11 pairs from 2000 to 2009 and currently supports only 14 pairs of spotted owls. The South Santiam, Horse Creek, and Hagan LSRs have never supported more than 11, 8, and 3 pairs of spotted owls, respectively (Appendix 3). It is important to note that the LSR design was intended to preserve late-successional forest ecosystems rather than to directly benefit any one species, however.

The first formal spotted owl reserve design recommended that 15 – 20 pairs of spotted owls would be necessary to support a stable population in a particular reserve (Thomas et al. 1990). The Northern Spotted Owl Recovery Plan also recommended that category 1 managed owl conservation areas (MOCAs) be capable of supporting at least 20 pairs, and category 2 MOCAs should be capable of supporting 1 – 19 pairs while also providing connectivity between category 1 areas (U.S. Fish and Wildlife Service 2008). The Fall Creek LSR corresponded closely to a category 1 MOCAs (OMOCA-08), and continued losses of pairs there may render that area ineffective as a reserve. The Horse Creek LSR also was within a category 1 MOCA (OMOCA-07), but it included wilderness that has not been surveyed recently so the capacity of the complete MOCA to support spotted owls cannot be extrapolated beyond the LSR portion. The South Santiam LSR corresponded closely to a category 2 MOCA (OMOCA-06), and the Hagan LSR was not included in a MOCA. These LSRs were not likely to support more than 20 pairs of spotted owls but may provide connectivity within the reserve network.

Table 8. Model selection results from the analysis of apparent survival in the central Cascades study area during the 2009 meta-analysis (from Forsman et al. 2009). Only competing models with $\Delta QAIC_c < 2.00$ are listed.

Model [a]	$QAIC_c$	$\Delta QAIC_c$	$QAIC_c$ weights	Number of parameters
φ[S1+(S2=A)]+t, p(s+t)	4659.00	0	0.08589	41
φ [S1+S2+A]+t, p(s+t)}	4659.22	0.2174	0.07705	42
φ (S1+(S2=A)]+CP, p(s+t)	4659.68	0.6792	0.06116	25
φ [S1+(S2=A)]+TT, p(s+t)	4659.80	0.8008	0.05755	25
φ (S1+S2+A]+CP, p(s+t)	4659.90	0.9028	0.05469	26
φ [(S1=S2)+A+CP, p(s+t)	4659.93	0.9344	0.05383	25
φ [(S1=S2)+A]+TT, p(s+t)	4660.12	1.1253	0.04893	25
φ [S1+S2+A]+TT, p(s+t)	4660.18	1.1819	0.04757	26

[a] Codes for model structure: φ = apparent survival probability, p = resighting probability, S1 = one-year-olds, S2 = two-year-olds, A = adults, s = sex, t = variable time effect, T = linear time trend, TT = quadratic time trend, CP = cut point time trend.

Productivity

Our primary measure of productivity was fecundity, which was estimated as the average number of female young produced by all territorial (adult and subadult) female owls. Fecundity was affected by the proportion of females that were paired, variation in the numbers of pairs that nest, variation in nest success, and variation in the number of young fledged by successful pairs. Environmental conditions may affect spotted owl productivity at all of these levels but it was evident that the rates of nesting attempts and nest failures were the primary factors that affected productivity in spotted owls. Relatively few females were confirmed to be single ($\bar{x}$ = 2.8%, SE = 0.56). Among those females that were paired and successfully fledged at least one young, there was little variation in the number of young produced (CV = 0.028). The percentage of pairs that attempted to nest was the most variable (CV = 12.99) followed by the percentage of nesting attempts that are successful (CV = 6.16).

A biannual pattern in nesting attempts was observed from 1988 through 2005. This pattern has been broken three times: once in 2000 through 2002 when high rates of nesting attempts were recorded three years in a row, again in 2005 and 2006 when low rates of nesting attempts were recorded for two consecutive years and most recently with two consecutive years of high rates of nesting attempts in 2007 and 2008. Climatic factors, particularly average daily temperature and amount of precipitation in the late winter and early spring, have been suggested as potential

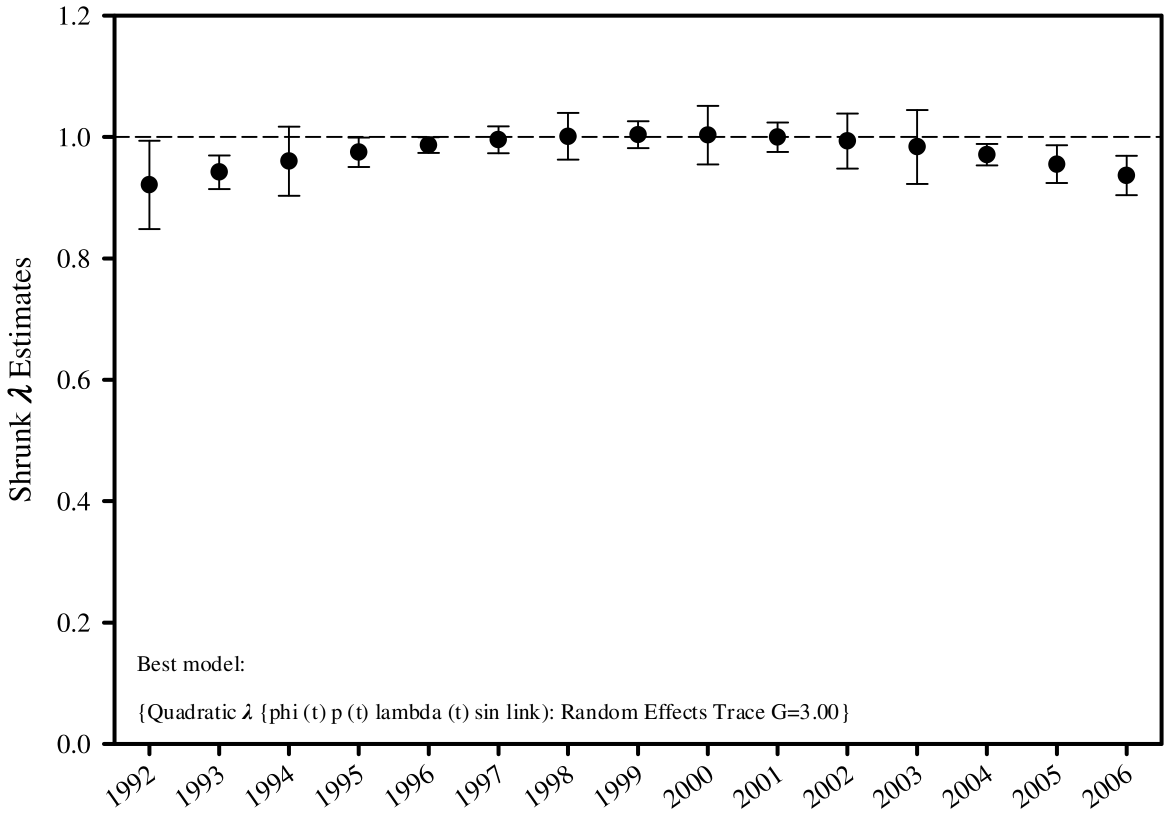

Figure 7. Estimates of the annual rate of population change (λ) under the best model ($QAIC_c$ weight = 0.50968) from the 2009 meta-analysis.

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causal mechanisms creating this pattern in northern California (Franklin et al. 2000). Pairs of spotted owls in the central Cascades of Oregon may be more likely to attempt to nest when temperatures are warm and precipitation is lower than in years when late season storms occur during the early stages of nesting.

Nest success has been highly variable among years, and it does not appear to correlate with the number of nesting attempts. Over eight of the past 21 intervals between years, decreases in the number of nesting attempts have been at least partially offset by increases in nest success (Figure 4). Increases in nesting attempts were accompanied by decreases in nest success in only four intervals and both estimates changed in the same direction for the remaining nine intervals. We speculate that episodic storm events before and after nesting was initiated may explain these observations.

The number of young fledged also may be affected by stochastic weather events, particularly when the young are less well developed. Six post-fledging mortalities were confirmed in 2008. Five of these occurred during a week of cold temperatures and heavy rain in early June shortly after the young left the nest. A similar cluster of fledgling mortalities also was observed in 2004

Table 9. Wilderness boundary sites surveyed concurrently with the demographic study in the central Cascades study area, Willamette National Forest, Oregon from 1997 – 2009.

Year	Sites surveyed [a]	Sites with pairs	Number of pairs producing young	Number of young fledged
1997	5	4	1	2
1998	5	5	1	1
1999	5	5	0	0
2000	5	3	0	0
2001	5	4	0	0
2002	5	2	0	0
2003	6[b]	3	0	0
2004	6	2	0	0
2005	6	5	0	0
2006	6	3	1	2
2007	6	3	3	4
2008	5	2	0	0
2009	6	3	0	0

[a] Includes only sites that were surveyed at least 3 times at night.
[b] One site previously within an LSR has been re-assigned to the wilderness based on the 3 most recent owl locations.

when a period of unseasonably cold and wet weather occurred during the same period. In contrast, weather conditions remained mild throughout June 2009, and no post-fledging mortalities were documented. The negative effect of precipitation during the late nesting season (1 May–30 June) on fecundity indicated by the meta-analysis (Forsman 2009) may reflect the periodic loss of young shortly after fledging.

Predation also may affect productivity both before and after fledging. However, direct observations or evidence of predation have been rare making it difficult to assess the magnitude of this effect. Barred owls affect spotted owl productivity through their effect on site occupancy by pairs of spotted owls (Olson et al. 2005). On two occasions in 2002, a dead nestling was found near a nest tree on the same day that a barred owl was observed aggressively interacting with the spotted owl pair. These kinds of inter-specific interactions may affect productivity by

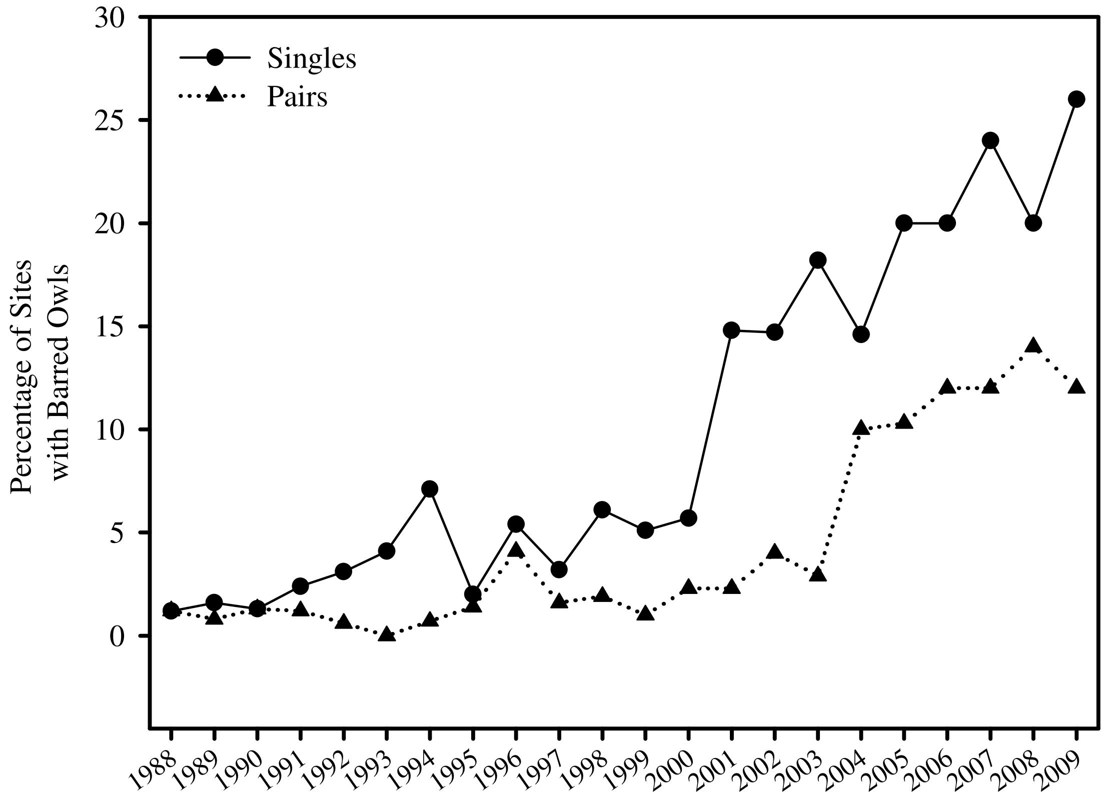

Figure 8. Percentage of sites where incidental detections of single and paired barred owls (*Strix varia*) have occurred while surveying for northern spotted owls in the central Cascades study area, Willamette National Forest, Oregon from 1988 – 2009.

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causing nest abandonment by spotted owls.

Spotted owl - barred owl relationships

Barred owls have become increasingly abundant in the study area. The overall percentage of sites with at least one barred owl increased slowly from 1988 – 1999 (Figure 7). An accelerated increase was observed through 2003, primarily with single barred owls while the rate of barred owl pair detections fluctuated at a low level. Since 2003, responses by pairs of barred owls have been increasing at nearly the same rate as single barred owl responses. Occupancy of sites by pairs of barred owls was probably underestimated because we did not use barred calls during our surveys, and we rarely located barred owls following nocturnal detections of single barred owls.

The effect of barred owls on spotted owl populations in the Oregon Cascades has been shown to negatively influence the probability of detecting spotted owls as well as the probability of a pair of spotted owls re-colonizing an abandoned site (Olson et al. 2005). Several banded spotted owls have not been relocated following barred owl detections in their historic core areas because they have been excluded from suitable habitat or were inhibited from responding to our surveys. While mortality of displaced non-juvenile spotted owls has not been documented in this study, recent results indicate that increased detections of barred owls throughout the study area were associated with decreased apparent survival (Forsman 2009, see below).

Spotted - barred owl hybrids have been located at 15 sites since 1999 (Appendix 5). Hybrid males were paired with barred owl females in 4 of 8 pairs. A male spotted owl was observed paired with a barred owl in one case and with a hybrid owl in a two cases. One case of a barred owl male paired with a hybrid female also has been observed. Reproduction has been observed between a male hybrid and a female barred owl (a total of 8 young fledged by 2 pairs) and between a male spotted owl and a female barred owl (2 young fledged). To date, female spotted owls have not been observed pairing with male barred or hybrid owls in this study area. This is consistent with other studies that indicated that female spotted owls rarely mate with barred or hybrid owls (Kelly 2001, Haig et al. 2004). We typically have not been following up on detections of single male barred owls, so we do not know how frequently female hybrid or spotted owls also are present.

2009 meta-analysis

The parameter estimates calculated at the January 2009 meta-analysis workshop support several of the occupancy and productivity estimates presented in our annual reports. The sharp decreases in pair occupancy from 1992-94, 2005-06, and 2008-09 are consistent with the quadratic time trend in λ in that significant population declines occurred during these intervals. Pair occupancy decreased at a lower rate from 1994-2004 and confidence intervals for these λ estimates include 1.0 (Figures 1 and 7). As discussed previously, both simple occupancy and pair occupancy are biased indices of population size, but changes in site occupancy are consistent with estimate of the rate of population change (λ).

The average fecundity estimate calculated during the meta-analysis weighted by age class was greater than the average fecundity estimate from the annual report, although the confidence intervals overlapped considerably (meta-analysis: weighted $\bar{x} = 0.312$, 95% CI: 0.223 – 0.343; annual report: $\bar{x} = 0.287$, 95% CI: 0.216 – 0.358). This slight difference is because a subset of the overall data set was used for the meta-analysis which did not include data from several sites that were monitored for only a few years. Additionally, more restrictive criteria were used in deciding which data could be included in the meta-analysis than had been applied for inclusion in the annual report during the early years of this study. This mostly affected pairs and single females that did not produce young; several of these observations were not included in the meta-analysis because an insufficient data were recorded on at least one of the visits to determine reproductive status.

The even/odd year effect included in the best fecundity models reflects the biannual pattern in the numbers of nest attempts. As discussed above, variation in the number of nest attempts appears to be a more important component of the even/odd year effect than the number of young produced by pairs that attempt nesting. This may reflect a “bet-hedging” strategy, although it is unclear what decision rules spotted owls may use to determine if nesting in a given year is likely to be successful. Although it seems plausible that owls may choose to nest when weather conditions are favorable, climate during the late winter and early nesting season were not included in the top fecundity models for this study area. It is likely that climate and as yet little-known factors such as prey availability interact in complex ways to influence the decision of whether or not to nest.

Possible causal factors included as covariates in the meta-analysis were barred owls, habitat change, and climate. In the HJA study area, barred owls exerted a strong negative effect on survival which is consistent with both empirical data (Olson et al. 2005) and anecdotal observations. A weak positive effect of barred owls on fecundity was indicated which is contrary to expectations. It is possible that this was an artifact of the influence of barred owls on the detectability of spotted owls. If non-nesting spotted owls were less detectable in the presence of barred owls, then pairs and females that do not produce young would be under-represented in the fecundity data. This would produce a positive bias in fecundity estimates. A year- and territory-specific barred owl covariate may ameliorate this bias by incorporating individual detection probabilities into the calculations.

The habitat covariate used in the meta-analysis was an estimate of the amount of suitable spotted owl habitat within 2.4 km of cumulative site center buffers by year (Forsman et al. 2009). The strong positive effect of the amount of habitat on fecundity suggests that habitat loss would cause a decrease in fecundity. Apparent survival was not affected by changes in the amount of habitat, but decreases in habitat availability may increase the likelihood of competitive interactions with barred owls. As a result, habitat losses may indirectly impact survival because of increased contact with barred owls.

Management considerations

From 2000 – 2004 and in 2007, the largest numbers of young were produced in the LSR allocation (Table 5). In 2005, 2006, 2008 and 2009, productivity in the LSRs was lower than in the matrix and AMA allocations. Most of the young produced in the LSR allocation have been from the Fall Creek LSR. Very few young have been produced in the Horse Creek and South Santiam LSRs, and young were rarely produced at all in the Hagan LSR (Appendix 4). The wide fluctuations in productivity in the Fall Creek LSR and the relatively low numbers of young produced since 2005 suggest that this area may not be a reliable source of recruits in the future. One possible reason for this has been the relatively high numbers of barred owls in the Fall Creek LSR. Since 2000, an average of 40% of all barred owl detections has been in the Fall Creek LSR (range: 27% – 44%). In most years, there has been nearly as many barred owls as have been detected in the matrix and AMA allocations combined (average percentage of barred owl detections = 43%, range: 33% – 61%). Although recent results do not support a negative effect of barred owls on fecundity in the HJA study area, declining survival in response to increasing barred owl populations obviously would impact productivity through the loss of potentially breeding spotted owls (Forsman et al. 2009).

Although the matrix and AMA allocations are subject to timber harvest, they still contain many productive spotted owl pairs that have made substantial contributions to population recovery. The strong association between the amount of habitat and productivity reported above underscores the importance of monitoring and protecting pairs of spotted owls outside of existing reserves. Given that timber harvest has resumed in the matrix and AMA allocations, it will be critical to continue keeping management agencies informed of the most recent locations of these productive pairs.

Two wildfires occurred on the study area in 2003. The Clark fire included three sites in the Slick Creek and Bedrock Creek watersheds in the Fall Creek LSR. This fire seems to have had little effect on site occupancy or productivity in this area. The Jones Creek (1013) spotted owl site was occupied by a pair from 2000 through 2002 that produced two young prior to the fire. From 2004 through 2006 this pair was still present and produced one young. In 2007 and 2008, Jones Creek was occupied by a non-nesting spotted-hybrid owl pair. West Slick Creek (4549) contained two nest trees, although one was used by a spotted-barred owl pair in 2001. This site remained unoccupied by spotted owls since the fire until 2006 when a subadult female was located with the male last seen in 2003 just before the fire. This site is no longer occupied by a pair and no young have been produced since the fire. North Slick Creek (4420) had not been occupied by a pair until after the fire and this pair fledged 2 young. This was the first documented reproduction in this site since 1996.

The B & B complex fire began late in the field season of 2003 and included only one site center (Lost Lake, MSNO 0815). This site contained four nest trees at elevations above 4,000 ft and has been occupied by a pair in 13 of 15 years. We located the historic pair near two of the previous nest trees in both 2004 and 2005. We detected an unidentified female during one night visit in late July of 2006. This site has been unoccupied since 2007 and the male from this site was relocated east of Carmen Reservoir approximately 7.5 miles south of Lost Lake in 2007. This fire may have negatively impacted the pair, although the effect of the fire was confounded by a pair of nesting great horned owls (*Bubo virginianus*) that were present approximately 200 - 300 m from the historic spotted owl nest trees in 2006.

Current and future plans for timber harvest will provide an opportunity to evaluate the effects of different harvest strategies on spotted owl site occupancy and demography. Plans are currently underway for a large-scale commercial thinning project in the Blue River watershed in the central Cascades AMA. This area contains several of the most productive pairs on the study area so it is critical that units are planned to minimize impacts on these pairs. Site- and year-specific data will be required to adequately assess the long-term effects of these actions. We continue to inform the Forest Service biologists of the most recent locations of the spotted owls in these areas.

8. **<u>Problems encountered</u>:**

The numbers of downed trees blocking Forest Service roads continued to hinder our access to many of our sites. Despite the efforts of Forest Service personnel to clear the roads, we spent several days throughout the field season clearing the roads rather than conducting site visits.

Although survey effort was the same for all three land allocations, more difficult access in the LSRs decreased detection probabilities by an unknown magnitude. Many of the secondary roads in the LSRs are no longer maintained and several have been decommissioned making portions of these sites difficult to survey effectively. More road closures occurred in 2009 and that is expected to continue in 2010.

The Horse Creek and South Santiam LSRs include most of our high elevation sites where more snow remains longer into the spring, which delays the first surveys until June when many spotted owls may have already attempted to nest and failed. As a result, the productivity of more owls remained unresolved in these LSR sites than in the matrix or AMA sites. Deeper and a more persistent snow pack also may influence the productivity of spotted owls in these LSRs.

9. Acknowledgments:

Several people from the Willamette National Forest contributed both information and equipment that made this study possible. Forest Service biologists Ruby Seitz, Penny Harris, and Shane Kamrath (McKenzie River Ranger District), Tiffany Young (Sweet Home Ranger District), and Dick Davis (Lowell Ranger District) regularly consult with us regarding management activities near the owl sites and have provided valuable information regarding the history of several sites. Sonja Weber (Willamette National Forest S.O.) and Janice Reid (Roseburg BLM) provided valuable assistance in revising master site numbers and site names to reconcile our database with the ODFW master site list. Shari Johnson (Pacific Northwest Forestry Sciences Laboratory), Mark Schulze (Oregon State University) and the staff of the H. J. Andrews Experimental Forest provided housing and office facilities. Financial support was provided by the U. S. Forest Service and the Portland Field Office of the U. S. Fish and Wildlife Service. We also thank Steve Adey for his continued service to the project as a weekend volunteer.

10. Research plans for FY 2010:

a) Continue the demographic study of the northern spotted owl population in the central Cascades of Oregon.

b) Continue comparing the demography of spotted owls among the matrix, AMA, and LSR land use allocations.

c) Increase efforts to locate, band, and obtain blood samples from spotted/barred owl hybrids.

d) Continue the analysis of spotted owl diet composition and update the prey database to be compatible with other studies.

e) Cooperate with the staff of the Middle Fork Ranger District in developing priorities for proposed management in the Fall Creek LSR.

f) Cooperate with the staff of the McKenzie River Ranger District in planning pre-commercial and commercial thinning operations in the Blue River watershed.

11. Publications and technology transfer completed in FY 2009:

Presentations

a) S. Ackers discussed spotted owl ecology and current monitoring efforts with a group of visiting ecologists from Hokkaido University, Japan (June 2009).

b) S. Ackers discussed spotted owl ecology with a group from the Inner City Youth Institute (August 2009).

c) S. Ackers presented a posted entitled "Long-term population monitoring of northern spotted owls: implications for current reserve designs" at The Wildlife Society's annual conference in Monterrey, CA (September 2009).

Technology transfer.

a) Project personnel coordinated spotted owl surveys with the district biologists of the Willamette National Forest and continued to provide information on spotted owl locations and demographics for their management needs.

b) S. Ackers provided data on occupancy and productivity of sites within 1.6 km of BLM and private land to the Eugene BLM, Westside Ecological (under contract with the Oregon Department of Forestry) and Weyerhaeuser Inc.

c) S. Ackers attended monthly H. J. Andrews staff meetings at the H. J. Andrews Experimental Forest.

12. Duration of the study:

This study was initiated in FY 1987 and is part of the long-term monitoring plan for the northern spotted owl under the Northwest Forest Plan.

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Appendix 1. Master site number (MSNO) and site name revisions as of 26 October 2009.

District	ODFW MSNO	ODFW Site Name	Previous MSNO	Previous Site Name
McKenzie River	0032	Upper Mcrae Creek	0033	Middle Mcrae Creek
	0033	Lower Mcrae Creek	3025	
	0085	Lamb Butte		Lowder Mountain
	0111	NF Quartz Creek		N Fk Quartz Creek
	0113	East Fork McKenzie	5043	E Fk McKenzie River
	0119	Middle Horse Creek	0982	
	0750	Pasture Creek	0850	
	0818	Horsepasture Mount		Horsepasture Mtn
	0821	Great Spring		Great Spg-Clear Lake
	0836	Lost Creek	2442	White Branch Creek
	0850	Upper Horse Creek	2824	
	0851	Lower Roney Creek	2835	
	0857	Lowder Mountain		Upper East Fork
	0869	EF Augusta Creek		E Fk Augusta Creek
	0871	Wolf Rock	2844	Mann Creek
	2465	Hagan Block	5071	
	2477	Gate Creek	5070	
	2826	Indian Fork	1414	Indian Creek
	2827	Lost Branch	0836	Lost Creek
	2831	Castle Creek	1737	
	4085	Upper Cook Creek	3962	
Middle Fork	1015	Slick Creek	4549	West Slick Creek
	1017	Tiller Ninemile		Tiller-Ninemile Cr
	1020	West Delp Creek	4421	Upper Delp
	1028	Lower Logan Creek	2858	Logan Creek
	1031	Briem Creek	4476	
	1032	Upper Pernot Creek	2888	
	1063	Delp Creek Tributary	1020	West Delp Creek
	1099	Upper Marine Creek	1028	Lower Logan Creek
	2463	Saturn Creek	1031	Saturn-Briem Creek
	2861	Little Fall Creek 2		Little Fall Creek Trib
	2867	South Puma Creek	4082	Pumarine

District	ODFW MSNO	ODFW Site Name	Previous MSNO	Previous Site Name
Middle Fork	4549	West Slick Creek	1015	Slick Creek
Sweet Home	0007	Burnside Creek	2956	Indian Tombstone
	0012	Indian Creek	4093	Indian Creek (Sweet)
	0013	Echo Creek		Echo Creek-Lost Prairie
	0064	Boulder Cr (Sweet)	0641	
	0668	Parks Creek	0664	
	0689	Upper Two Girls	5052	
	0694	Squaw Mountain	4098	
	1156	Gordon Meadows	0646	
	1322	Gordon Meadows West	5058	
	2964	East Wildcat		East Wildcat Mountain

Appendix 2. Occupancy [a] and reproductive [b] status of northern spotted owls in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 2004 – 2009. Data from prior years are available upon request.

		2004		2005		2006		2007		2008		2009	
LSR	MSNO [c]	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.
Fall Creek (LSR-219)	0124	P	N	P	F	P	N	P	1	P	0	P	2
	1012	A	2	P	Unk.	SU [d]	-	RM	-	SD	-	Unoccupied	
	1013	P	1	P	0	P	N	P [d]	0	P [d]	0	P [d]	N
	1015	Unoccupied [d]		Unoccupied [d]		P [d]	N	SU	-	Unoccupied		Unoccupied	
	1016	P	0	P	F	SU [d]	-	PU	Unk.	Unoccupied		SU	-
	1017	SU	-	SU	-	SU	-	Unoccupied		Unoccupied		Unoccupied	
	1018	A	Unk.	P	0	P	N	P	0	RF	0	A	N
	1019	SU	-	SU	-	Unoccupied		SU	-	NR	-	Unoccupied	
	1020	P	0	P	0	P	N	P	1	P	1	P	N
	1021	P	2	P	Unk.	P	N	P	0	P	0	P	N
	1022 [g]	P	2	RF	N	RM	-	P	0	P	0	A	0
	1022 [g]	-	-	-	-	-	-	-	-	P	1	Unoccupied	
	1028 [e]	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	1029	P	2	P	N	PU	Unk.	P	2	P	0	P	0
	1031	Unoccupied [d]		Unoccupied [d]		Unoccupied [f]		Unoccupied [d]		NR	-	RF	0
	1032	PU	0	P	F	P	N	P	0	P	0	P	N
	1043	Unoccupied		Unoccupied		Unoccupied		SU	-	Unoccupied		Unoccupied	
	1063	P	2	P	N	P	N	P	1	P	0	P	1
	1099	NR	-	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	1101	Unoccupied		Unoccupied		SU	-	Unoccupied		NR	-	Unoccupied	

LSR	MSNO[c]	2004 Occ.	2004 Repro.	2005 Occ.	2005 Repro.	2006 Occ.	2006 Repro.	2007 Occ.	2007 Repro.	2008 Occ.	2008 Repro.	2009 Occ.	2009 Repro.
Fall Creek (LSR-219)	1102	P	2	P	Unk.	P	N	P	2	P	1	P	N
	2444	P[d]	0	Unoccupied		P[d]	0	P	0	SU	-	RM	-
	2462	SU	-	NR	-	P	0	P	1	P	0	P	N
	2463	P	2	RM	-	Unoccupied		SU	-	P	0	RF	0
	2807	P	1	A	Unk.	P	N	P	1	P	0	P	1
	2808	P	2	P	0	P	N	P	2	P	1	P	N
	2817	P	2	P	N	A	N	P	1	P	2	Unoccupied	
	2826	PU	N	P	N	RM	-	P	0	SU	-	SU	-
	2861	SU[d]	-	Unoccupied[d]		Unoccupied		SU	-	SU	-	Unoccupied	
	2863	SU	-	PU	Unk.	Unoccupied		Unoccupied		NR	-	Unoccupied	
	2864	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2865	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		RM	-
	2867	Unoccupied		SU	-	SU	-	Unoccupied		Unoccupied		Unoccupied	
	2889	P	0	P	F	P	Unk.	P	2	P	0	P	N
	2891	P	N	P	Unk.	SU	-	Unoccupied		Unoccupied		Unoccupied	
	2895	P	N	P	N	P	N	P	Unk.	Unoccupied		Unoccupied	
	2897	Unoccupied[d]		Unoccupied		Unoccupied		Unoccupied		SU	-	SU	-
	2900	PU	Unk.	P	Unk.	P	Unk.	Unoccupied		SU	-	RM	-
	2949	SU	-	Unoccupied		SU	-	SU	-	SU	-	RM	-
	3550	P	1	P	N	P	N	A	0	P	0	P	N
	4105	Unoccupied		Unoccupied		Unoccupied		Not surveyed		Not surveyed		NR	-
	4392	SU[d]	-	P[d]	F	P	N	SU[d]	-	SU[d]	-	RM	-
	4420	PU	N	P	Unk.	P[d]	Unk.	P	2	RM	-	Unoccupied	

		2004		2005		2006		2007		2008		2009	
LSR	MSNO[c]	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.	Occ.	Repro.
Fall Creek (LSR-219)	**4549**	SU[d]	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	4585	P	1	P	N	SU[d]	-	SU	-	SU	-	Unoccupied	
Hagan (LSR-215)	0112	Unoccupied		Unoccupied		Unoccupied		Unoccupied		NR	-	Unoccupied	
	2465	Unoccupied		SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2477	SU	-	RF	Unk.	PU	Unk.	Unoccupied		Unoccupied		Unoccupied	
	3401	P	N	RM	-	P	N	RM	-	Unoccupied		P	0
	4503	P	F	RM	-	PU	Unk.	P	0	P	0	P	0
Horse Creek (LSR-218)	**0085**	SU	-	RF	Unk.	PU	Unk.	A	2	NR	-	SU	-
	0113	RM	-	Unoccupied		Unoccupied		SU	-	Unoccupied		SU	-
	0119	P	1	RF	N	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	0750	P	1	SU	-	P	Unk.	P	0	P	0	RM	-
	0818	P	0	P	Unk.	SU	-	RM	-	RM	-	A	0
	0834	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	0857	Unoccupied		RM	-	Unoccupied		Unoccupied		P	Unk.	P	0
	1736	P	0	P	1	P	N	A	Unk.	PU	Unk.	SU	-
	2428	P	2	P	N	P	1	P	0	P	0	P	2
	2446[d]	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		SU	-
	2828	SU	-	Unoccupied		Unoccupied		Unoccupied		SU	-	Unoccupied	
	2830	P	2	SU	N	SU	-	SU	N	P	Unk.	A	0
	2831	P	0	RM	-	RM	-	P	0	P	Unk.	P	0
	3023	P	1	P	N	P	Unk.	P	2	Unoccupied		P	0
S. Santiam (LSR-217)	**0007**	PU	0	A	0	RM	-	P	2	P	0	P	0
	0011	P	2	P	N	P	1	PU	Unk.	Unoccupied		RM	-

LSR	MSNO[c]	2004 Occ.	2004 Repro.	2005 Occ.	2005 Repro.	2006 Occ.	2006 Repro.	2007 Occ.	2007 Repro.	2008 Occ.	2008 Repro.	2009 Occ.	2009 Repro.
S. Santiam (LSR-217)	0014	SU	-	PU	Unk.	Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	0064	Unoccupied		Unoccupied		RM	-	Unoccupied		Unoccupied		Unoccupied	
	0619	SU	-	P	N	P	N	P	0	P	0	P	0
	0689	Unoccupied		P	0	P	N	P	0	P	0	Unoccupied	
	0694	Unoccupied		Unoccupied		Unoccupied		P	0	RM	-	P	0
	1156	SU	-	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	1322	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		SU	-
	2460	Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied		Unoccupied	
	2846	--		P	N	P	N	P	0	SU	-	RM	-
	2959	P	1	P	N	RM	-	P	0	P	1	P	0
	2962	P	1	P	Unk.	Unoccupied		Unoccupied		NR	-	Unoccupied	
	4196	P	F	P	1	P	N	SU	-	SU	-	Unoccupied[d]	
	4405	P	1	P	Unk.	RM	-	P	1	SU	-	P	0
	4488	RM	-	P	Unk.	Unoccupied		Unoccupied		Unoccupied		Unoccupied	

[a] Occupancy status: P = pair; A = pair plus one or more additional adults or subadults; RM = resident single male; RF = resident single female; PU = pair detected, only one meets residency criteria; SU = one or more owls detected but not meeting the above criteria and survey effort ≥ 3 night visits; SD = one or more owls detected but not meeting the above criteria and survey effort < 3 visits; NR = no responses in < 3 night visits. Subscripts indicate that hybrids also were located at the site.
[b] Reproductive status: 0, 1, 2, 3 = number of young produced; N = non-nesting; F = nest failure; Unk. = undetermined.
[c] Master Site Numbers in bold are new or corrected numbers. Please see Appendix 1 for the master site number revisions.
[d] Spotted/barred owl hybrid(s) identified at this site (see Appendix 5).
[e] The Logan (2858) and L. Logan (2899) sites have been surveyed as a single site since 2000 and are now designated Logan Creek (1028) (see Appendix 1).
[f] A spotted owl x barred owl pair produced two hybrid fledglings at this site in 2006.
[g] Two pairs of spotted owls were located at two different historic site centers at this site.

Appendix 3. Summary of survey effort and site occupancy in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 – 2009.

LSR	Year	Sites surveyed	Occupied [a] sites (%)	Sites occupied by pairs (%)
Fall Creek (LSR-219)	1997	0	-	-
	1998	23	17 (74)	13 (57)
	1999	36	30 (83)	23 (64)
	2000	40	33 (83)	25 (63)
	2001	40	34 (85)	24 (60)
	2002	41	36 (88)	25 (61)
	2003	41	35 (85)	21 (51)
	2004	40	31 (78)	24 (60)
	2005	42	30 (71)	24 (57)
	2006	42	30 (71)	20 (48)
	2007	42	30 (71)	20 (48)
	2008	36	25 (69)	16 (44)
	2009	41	23 (56)	14 (34)
Hagan (LSR-215)	1997	3	2 (67)	1 (33)
	1998	4	3 (75)	2 (50)
	1999	5	3 (60)	0
	2000	5	3 (60)	1 (20)
	2001	5	5 (100)	2 (40)
	2002	5	2 (40)	1 (20)
	2003	5	3 (60)	2 (40)
	2004	5	3 (60)	2 (40)
	2005	5	4 (80)	1 (20)
	2006	5	3 (60)	3 (60)
	2007	5	3 (60)	1 (20)
	2008	4	1 (25)	1 (25)
	2009	5	2 (40)	2 (40)

LSR	Year	Sites surveyed	Occupied [a] sites (%)	Sites occupied by pairs (%)
Horse Creek (LSR-218)	1997	12	8 (67)	3 (25)
	1998	14	9 (64)	7 (50)
	1999	13	9 (69)	7 (54)
	2000	13	8 (62)	7 (54)
	2001	13	9 (69)	4 (31)
	2002	14	8 (57)	3 (21)
	2003	14	10 (71)	7 (50)
	2004	14	11 (79)	8 (57)
	2005	14	10 (71)	4 (29)
	2006	14	8 (57)	5 (36)
	2007	14	9 (64)	6 (43)
	2008	13	8 (62)	6 (46)
	2009	14	11 (79)	6 (43)
S. Santiam (LSR-217)	1997	12	9 (75)	4 (33)
	1998	14	9 (64)	5 (36)
	1999	12	10 (83)	5 (42)
	2000	15	11 (73)	2 (13)
	2001	15	8 (53)	4 (27)
	2002	15	8 (53)	5 (33)
	2003	15	8 (53)	6 (40)
	2004	15	10 (67)	6 (40)
	2005	16	11 (69)	11 (69)
	2006	16	9 (56)	5 (31)
	2007	16	9 (56)	8 (50)
	2008	15	8 (53)	4 (27)
	2009	16	8 (50)	5 (31)

[a] Sites were considered occupied if they were surveyed at least three times at night with one or more responses that could not be attributed to any other site.

Appendix 4. Summary reproductive statistics in the four late-successional reserves (LSR) in the Central Cascades Study Area, Willamette National Forest, Oregon from 1997 – 2009.

LSR	Year	Nesting surveys [a]	Pairs nesting	Reproductive surveys [b]	Pairs fledging young (%)	Young fledged	Young per successful pair	Young per all pairs
Fall Creek (LSR-219)	1997	Fall Creek not surveyed by OCFWRU staff in 1997.						
	1998	9	7	10	4 (40)	8	2.00	0.80
	1999	8	2	12	4 (33)	8	2.00	0.67
	2000	11	9	19	12 (67)	20	1.67	1.05
	2001	13	6	23	15 (65)	24	1.60	1.04
	2002	17	14	22	15 (71)	27	1.80	1.23
	2003	14	2	18	2 (11)	4	2.00	0.22
	2004	19	12	23	13 (59)	22	1.69	0.96
	2005	14	6	17	0	0	0	0
	2006	15	0	16	0	0	0	0
	2007	14	9	20	11 (58)	16	1.45	0.80
	2008	8	4	18	5 (29)	6	1.20	0.33
	2009	8	2	13	5 (38)	4	1.33	0.31
Hagan (LSR-215)	1997	1	1	0	0	0	0	0
	1998	1	1	1	0	0	0	0
	1999	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0
	2001	1	1	2	2 (100)	3	1.50	1.50
	2002	1	0	1	0	0	0	0
	2003	1	1	1	0	0	0	0
	2004	2	1	2	0	0	0	0
	2005	0	0	0	0	0	0	0
	2006	1	0	1	0	0	0	0
	2007	1	0	1	0	0	0	0
	2008	1	0	1	0	0	0	0
	2009	1	1	2	0	0	0	0
Horse Creek (LSR-218)	1997	2	0	3	0	0	0	0
	1998	2	0	6	2 (40)	2	1.00	0.33

LSR	Year	Nesting surveys [a]	Pairs nesting	Reproductive surveys [b]	Pairs fledging young (%)	Young fledged	Young per successful pair	Young per all pairs
Horse Creek (LSR-218)	1999	4	2	4	1 (20)	2	2.00	0.50
	2000	3	2	3	1 (33)	1	1.00	0.33
	2001	2	1	4	3 (60)	6	2.00	1.50
	2002	2	1	3	1 (33)	1	1.00	0.33
	2003	3	1	5	2 (50)	3	1.50	0.60
	2004	2	2	8	5 (63)	7	1.40	0.88
	2005	3	0	4	1 (25)	1	1	0.25
	2006	2	1	2	1 (50)	1	1	0.50
	2007	3	1	6	2 (40)	4	2	0.67
	2008	1	0	2	0	0	0	0
	2009	1	1	5	1 (20)	2	2	0.40
S. Santiam (LSR-217)	1997	4	2	5	0	0	0.00	0.00
	1998	4	2	5	1 (25)	2	2.00	0.40
	1999	1	0	4	0	0	0.00	0.00
	2000	1	1	2	1 (50)	1	1.00	0.50
	2001	2	2	3	2 (67)	4	2.00	1.33
	2002	2	2	3	3 (100)	3	1.00	1.00
	2003	3	1	6	1 (17)	2	2.00	0.33
	2004	4	4	6	4 (67)	5	1.25	0.83
	2005	4	1	7	1 (14)	1	1.00	0.14
	2006	4	1	5	1 (20)	1	1	0.20
	2007	3	1	7	2 (29)	3	1.50	0.43
	2008	4	2	4	1 (25)	1	1.00	0.25
	2009	2	0	5	0	0	0	0

[a] Includes pairs and females given at least four mice on at least two occasions by 31 May and all females examined for a brood patch by 30 June.
[b] Includes all pairs and females given at least four mice on at least two occasions by 31 August.

Appendix 5. Summary of spotted/barred hybrid owl activity in the Central Cascades Study Area, Willamette National Forest, Oregon from 1999 – 2009.

Year	MSNO	Male species [a]	Female species	Number of young fledged	Additional STOC observations
1999	1015	STXX	STVA	1	Pair, reproduction unknown
2000	1015	STXX	STVA	Unknown	None
2001	1015	STXX	--	--	Female, 1 auditory detection
	4549	STOC	STVA	2	None
2002	1015	STXX [b]	STVA	2	None
	2446	STVA	STXX	Unknown	Male, 1 auditory detection
2003	1015	STXX [b]	--	--	None
	1013	--	STXX [c]	Unknown	Resident male
	1031	STXX	--	--	Male, 1 auditory detection
2004	1015	STXX	STVA	Unknown	Male, 1 auditory detection
	1031	STXX [d]	STVA	2 [e]	None
	2897	--	STXX [f]	Unknown	Male, 1 auditory detection
	2861	STXX	STVA	Unknown	Male, visual identification
	2447	--	STXX	Unknown	Pair, 1 auditory detection
	4392	STXX [g]	STVA	Unknown	Pair, 1 auditory detection
	4549	STXX	--	--	None
	2444	STOC	STXX [c]	Non-nesting	None
2005	1015	STXX	STVA	Unknown	Unk. sex, 1 auditory detection
	1031	STXX [h]	STVA	1 [i]	None
	2861	STXX	--	Unknown	Unk. sex, 1 auditory detection
	4392	STXX	--	Unknown	Pair, failed nesting attempt
2006	1012	STXX	--	Unknown	Male, visual, not identified
	1015	STXX	STVA	Unknown	None
	1016	STXX	--	Unknown	Male, visual identification
	1031	STXX [d]	STVA	2 [e]	None
	2410	--	STXX	Unknown	Pair, no young produced
	4420	STXX	--	Unknown	Pair, 1 auditory detection

Year	MSNO	Male species [a]	Female species	Number of young fledged	Additional STOC observations
2006	4585	STXX	--	Unknown	Female, 2 auditory detections
	2444	STOC	STXX [c]	Non-nesting	None
2007	1013	STOC	STXX	0	None
	2413	--	STXX	0	Pair, non-nesting
	4392	STXX	--	Unknown	None
2008	1013	STOC	STXX [c]	0	Male, 1 auditory detection
	4392	STXX	--	Unknown	Male, 3 auditory detections
2009	1013	STOC	STXX [c]	0	Male, 2 auditory detections
	4392	STXX	--	Unknown	Male, 3 auditory detections

[a] STOC = northern spotted owl, STVA = barred owl, STXX = spotted/barred owl hybrid.
[b] Banded as an adult on 9 June 2002; orange/yellow tab, left leg.
[c] Banded 141 km SSW of the study area as a fledgling on 21 June 2001, color band replaced 30 April 2003: pink/white dots/orange tab, left leg. This owl was also re-sighted at site 1032 on 13 August 2003.
[d] Banded as an adult on 17 May 2004; green/white triangles, right leg.
[e] One F2 fledgling banded on 21 June 2004; white/red triangles, left leg.
[f] Banded as an adult on 26 May 2004; black/white dots/white tab, left leg.
[g] Banded 103 km SW of the study area as a 2-year-old on 11 March 2003, re-sighted on the study area on 19 May 2004; green/white diagonals/orange tab, left leg.
[h] Lost original color band. New band attached on 20 June 2005; pink/white dots/black tab, right leg.
[i] Single fledgling banded on 20 June 2005; red/white stripe, left leg.